U.S. Department of State
U.S. Agency for International Development

Geographic Information for Sustainable Development

GISD

Selected Project Summaries with CD Insert

Public-private partnerships will be crucial to find the money needed to help nations address the daunting problems that they face in developing.

Like scientific knowledge, globalization in and of itself isn't a force for darkness or a force for light; the issue is how we respond to this powerful force, how we use it to create hope for ordinary men, women and children around the world.

We are convinced that with good governance, solid economic policies, and with the responsible application of science and technical knowledge, globalization will be a positive force for the overwhelming majority of people on this planet.

Remarks to the National Academy of Sciences Annual Meeting by Secretary Colin L. Powell, Washington, DC, April 30, 2002

Globalization is partly a result of the tremendous advances in information technology that have, in effect, shrunk the world and linked distant parts of the Earth, creating global relationships.

It is important to develop effective systems and mechanisms that can better provide needed scientific and technical knowledge to support local efforts to address the needs of both the environment and the poor.

Article on Poverty and Environmental Degradation by Akin L. Mabogunje, Chairman of the Development Policy Centre, Ibadan, Nigeria, published in Environment, vol. 44, no. 1, January/February 2002, pp. 9 - 18.

The Geographic Information for Sustainable Development Project joins State, USAID, and the technical agencies of the U.S. government with the Open GIS Consortium, the largest industry association of GIS technology services. It is a wonderful illustration of how public-private partnerships can be a force multiplier, leveraging resources for development.

Remarks to the Brookings Institute and the Council on Foreign Relations by Undersecretary of State for Global Affairs Paula Dobriansky, Washington, DC, May 23, 2002.

Under an initiative called the Global Development Alliance, these organizations (foundations, nongovernmental organizations (NGOs), universities, and most significantly, private companies) are joining the U.S. government as partners in helping developing nations chart a course toward sustainability. One-third of USAID's budget flows through international and American-based NGOs to the developing world. Another third is distributed through universities, private associations, and locally based NGOs. The final third is spent through the private sector.

With these partners, USAID will build alliances to target specific development objectives, matching our resources with theirs to accomplish those objectives. We've joined with a software company to bring Internet access and computer training to the developing world.

Foreign Assistance Builds a Foundation for Sustainability, by USAID Administrator Andrew S. Natsios. Article in Achieving Sustainable Development—an electronic journal of the U.S. Department of State, April 2002, Vol. 7, No. 1.

INTRODUCTION

About 340 million people—half of Africa's population—live on less than one dollar a day. Continued high population rates, coupled with the global economic slowdown, falling commodity prices, the debilitating effects of HIV/AIDS, natural disasters and conflict have hit the Sub-Saharan region of Africa particularly hard. The sub-continent experienced virtually no economic growth in the 1990s and almost half of the countries in this region had lower Gross Domestic Product (GDP) per capita at the beginning of the millennium than they did in 1980.

To reverse this situation, concerted action is required on a number of fronts: increasing agricultural productivity and trade, diversification of economic bases, building human capacity through improved educational opportunities (especially for girls), broadening the flow of information, strengthening African capacity to manage economic resources, and enhancing conditions for trade and investment. The Geographic Information for Sustainable Development (GISD) project aims to improve the quality, accuracy, and availability of data needed to better understand and monitor the environment and to harness science and technology in support of sustainable development.

The United States seeks to achieve sustainable development and regional stability in Africa. In cooperation with other partners in Africa and the international community, the United States promotes indigenous African capacity to respond to this complex set of issues through support of transparent and accountable governance structures, preservation of the richness and diversity of Africa's natural environment, and sound management of the continent's resource base. Through the Global Development Alliance (GDA), the U.S. encourages the formation of new alliances and partnerships with the corporate sector, foundations, universities, and non-governmental organizations (NGOs). The number of alliances is growing steadily, particularly in agriculture, education, health, environment, and information technology.

During the past decade, a number of African countries began taking advantage of geographic information (GI) science, technologies, and other elements of what specialists call spatial data infrastructure (SDI). They use these technologies to inventory their natural resources and to formulate strategies for sustainable development. They join in collaborations with global partners, forming public-private partnerships with other governments, businesses and NGOs. They apply science-based approaches, not only to solve age-old problems, but to prepare for future challenges as well.

Recent applications of data from Landsat and other satellite earth observation systems, the Global Positioning System (GPS), geographic information systems (GIS), and database management are creating opportunities and tools to understand and analyze problems in a manner which was not possible when global leaders sought to bridge the digital divide in Africa. Now, some African communities use these vital tools to monitor deforestation, assess land degradation, provide early warning of famine, predict disease outbreaks, aid food security, and develop new strategies to manage natural resources. Geographic Information sharing is also promoting greater transparency and accountability at the national level.

This booklet outlines select projects to illustrate some of the partnerships which are forming, how the capacity to use information technologies is increasing, and how GI science and technology is being applied to support decision-making. They represent a very small portion of the efforts currently underway. A CD is enclosed at the end of this booklet to provide information on these and other ongoing efforts. Also consult: **http://www.opengis.org/gisd** to obtain more detailed information on the truly global alliance which has formed to promote GI cooperation and capacity building in Africa.

Western Africa

In Sanambele, Mali, farmers use rock bunds to plug gulleys and to trap soils for cultivation.

Farmer Coulibaly's sorghum fields were reclaimed from once unproductive land. Rock lines are used in cropland to help prevent rainfall runoff and erosion.

Soil and Water Conservation, Food Security, and Land Degradation

Climatic forces, such as declining rainfalls and temperature increases, coupled with human actions, such as unsustainable agricultural practices, overgrazing and deforestation, speed the process of land degradation. Farmers can be part of the problem and they are the first to suffer from land degradation, but they are also the key to workable solutions.

Faced with ever-increasing pressures on the land, farmers in the Upper Niger River Basin have responded by intensifying land husbandry and crop diversification. Over the past twelve years, more than 30,000 farmers have adopted natural resources management practices that increase crop productivity, reclaim degraded lands, reduce fallow periods, and diversify household economies. As an example of pioneering approaches taken in the region, villages negotiated agreements with the Malian Forest Service that allowed them to assume management responsibility for their forests. In a recent sample of forest cover in nine villages, the rate of land degradation had been reduced, or even reversed, in seven out of the nine villages.

Farmers also use 'zai' (pits dug in their fields) for planting, increasing the efficiency of water and fertilizer use.

In Burkina Faso's central plateau, thousands of farmers have adopted soil and water conservation practices since the 1980s. These practices are leading to rehabilitation of degraded land, agricultural intensification, and economic renewal.

Climate data, agricultural data, satellite images, aerial photography, topographic maps and population data are all used in Burkina Faso to monitor agricultural production and strengthen national early warning systems designed to strengthen food security. This program, supported by international organizations and other governments, allows the government of Burkina Faso to initiate corrective measures in advance of an emergency. Burkina Faso also uses GI science and technology to support national land-use planning and to assess the constraints, the potentialities and the distribution of the country's natural resources. As part of an integrated water resource management plan, Burkina Faso uses GPS and GIS technologies to map existing wells and equipped boreholes, and to plan locations for new wells.

Côte d'Ivoire uses a database with precise information on roads and bridges not just to help with maintenance, but also in discussions with financial institutions on transportation planning. GI also supports Côte d'Ivoire's efforts towards an integrated national development plan, taxation reform, healthcare planning, and management of forests.

In The Gambia, GI supports urban planning in the Greater Banjul Area, which is projected to increase by more than half a million people by 2005. Digital data to assess food-aid requirements in The Gambia are used also to periodically monitor land-use changes throughout the country. This information is shared at the local level and farmers, in turn, are able to make adjustments based on climate forecasts to sustain or increase crop production.

We must spare no effort to free all of humanity, and above all our children and grandchildren, from the threat of living on a planet irredeemably spoilt by human activities, and whose resources would no longer be sufficient for their needs.

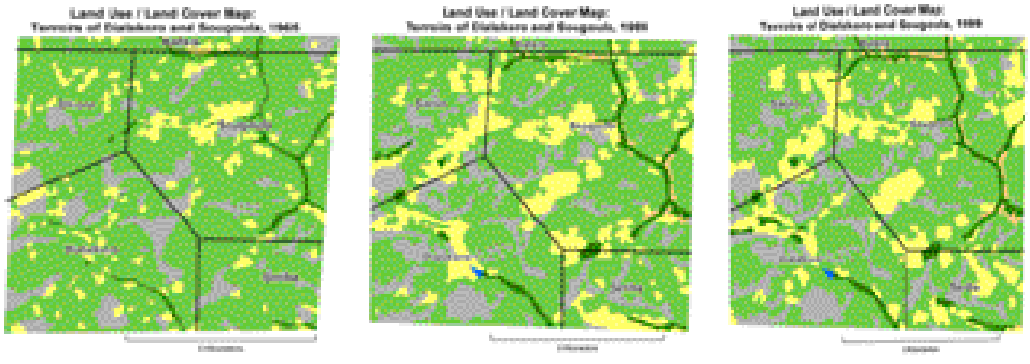
United Nations Millennium Declaration

Rehabilitating degraded croplands is a major step in addressing food security and alleviating poverty. Documenting poverty, and understanding why others are more vulnerable or at risk provides governments with information needed for poverty reduction campaigns. To this end, Stone Environmental, Inc. (SEI) conducted a two-phase project to assist the Government of Niger in developing a system to monitor poverty reduction. In the first phase, SEI compiled available in-country information to support a monitoring and evaluation system and created a Preliminary Atlas of Poverty and Vulnerability of Niger. This information system supported a Community Action Program and a Poverty Reduction Program. In the second phase, SEI worked with the government, community and NGOs to examine and propose a viable institutional framework leading to the creation of a National Information System to reduce poverty.

Much is being done in Africa to translate remote sensing data into timely, realistic and useable information for local decision-makers, including extension services, farmers associations, and NGOs. As a result, GI science is beginning to improve the quality of public decision-making in Western Africa, particularly with respect to the environment, natural resources management, and poverty alleviation. But its application is not common in many other important sectors as governments are only at an early stage of applying GI-based scientific analysis. In sectors where it is being applied, however, GI science brings transparency to how governments make decisions on resource pricing, allocations, concessions, revenues and use, and encourages decentralization in the decision-making process. Broad-based capacity-building initiatives are also underway, with a focus on the formation of private marketing and distribution networks.

In addition to the economic and social benefits to local populations derived from rehabilitation of degraded lands, soil fertility management also yields important regional and global benefits, in terms of increased carbon sequestration. In Senegal, the University of Arizona and the EROS Data Center of the U.S. Geological Survey (USGS) are working with the Senegalese Agricultural Research Institute (ISRA) and the Ecological Monitoring Center (CSE) to evaluate the sequestration of carbon in semi-arid and sub-humid parts of Africa. Together, they are devising linkages between carbon sequestration strategies and various farming systems. In this way, national programs, which encourage sustainable agriculture and rural development, also make positive steps towards lowering atmospheric carbon dioxide while remaining based on local methods and practices. The project entitled, Sequestration of Carbon in Soil Organic Matter (SOCSOM), is a truly collaborative and interdisciplinary effort involving mapping of land cover changes, carbon modeling and extensive ground measurements.

Nearly 40 years of satellite imagery and aerial photography are used to monitor and map significant agricultural transformations and land cover patterns at dozens of sites in Burkina Faso and Mali.



Time-series satellite images are used to make local land use/land cover maps that depict changing land use practices. Expansion of cropland in these communities of southern Mali was significant until the late 1980s when intensification stabilized the expansion, preserving large portions of the village lands in their natural state.

Central Africa and Great Lakes

Land Management and Community Involvement

The Kigezi highlands of southwest Uganda are an intensively cultivated portion of the Central African eco-region known as the "bread basket." The highlands provide 50 percent of Uganda's staple foods, strategic cash crops (such as tea and coffee) and contain a high concentration of Uganda's rural population. Land inheritance practices have contributed to the division of land into small, often fragmented farms. Unsustainable land use, poor infrastructure, low wage rates and increasing HIV infection rates have had an adverse impact on rural families, forcing many to seek employment elsewhere.

Photo Credit: NACOBTA: Helge Denker

Through such organizations as the International Centre for Research in Agroforestry (ICRAF) and the African Highlands Initiative (AHI), a community-based "farming-system" approach was established with farmer, village and district-level participation in determining approaches to improve soil conservation, cropping systems, pest and disease management, and to facilitate communication and information flows. An experimental telecenter was established as a private enterprise for such activities as literacy classes and field demonstrations. Satellite locations were also established to enhance communication between rural and service sectors.

Future activity will include the development of a comprehensive multi-layer GI database for seven districts in southwest Uganda, at various scales. Available databases (including the Uganda National Biomass Survey data) will be combined with field data and remote sensing data. Data will be collected on both biophysical attributes of landscapes and socio-economic and cultural criteria necessary to evaluate production systems. These tools will

Photo Credit: NACOBTA: Helge Denker

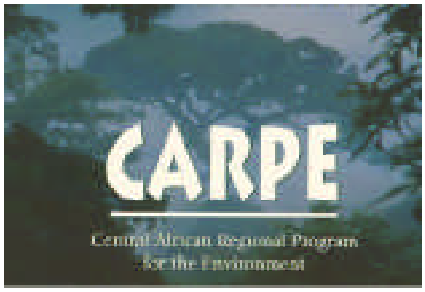
be used in modeling future scenarios, which will help guide local communities in adopting cost-effective watershed and hillside management strategies.

Agroforestry technologies are also being scrutinized for on-farm testing. Various tree species have been selected for improving soil fertility, using improved fallows and biomass transfer. Degraded areas have been reallocated to wood and pole production. Fodder tree species have been incorporated into hedgerows and along conservation boundaries, and fruit trees have been introduced and distributed by NGOs and extension services: the Agroforestry Research Networks for Africa (AFRENA), the National Agricultural Research Organization of Uganda (NARO), ICRAF, and Africare.

More than 25 farmer groups under the direct auspices of AHI participated in farmer-led adaptive research activities in soil fertility, farming system intensification and crop diversification. Focus areas included wheat (with the International Maize and Wheat Improvement Center, (CIMMYT) and NARO); climbing bean and root rot resistant bean (with the Eastern and Central Africa Bean Research Network (ECABREN), the International Center for Tropical Agriculture (CIAT), and NARO); sorghum and maize (with NARO), potato and bean seed systems (with the International Potato Center (CIP) and NARO), and tree species (with AFRENA, NARO, and ICRAF).

Capacity building is an integral part of the above activities. ICRAF's GI science lab, at its headquarters in Nairobi, is set up to train nationals of participating countries. ICRAF uses a participatory approach, which enhances the usefulness of the tools, and makes it easier to train local users in their application. Data collection and analysis also involve local expertise.

The Congo Basin contains the largest remaining expanse of tropical moist forest in Africa and the second largest in the world, which makes it one of the most important reservoirs of and sinks for atmospheric carbon. If the rate of deforestation in the Congo Basin begins to follow the trajectory of West Africa, the forest's role as a sink for atmospheric carbon would be significantly reduced. The Congo Basin is also critically important in terms of biodiversity and supports a wide range of flora and fauna, many of which have significant economic value. The Central African Program for the Environment (CARPE) is a major effort through which the conditions and practices required to maintain forest cover and to maintain biodiversity are identified. CARPE engages local NGOs, individuals and government agencies in activities to evaluate threats to forest integrity and to create opportunities for minimizing resource degradation while promoting economic development. The program is active in the Basin states of Cameroon, Central African Republic, Equatorial Guinea, Gabon, Republic of Congo, Democratic Republic of Congo, Rwanda, Burundi, and SaoTome and Principe, and is implemented by a team composed of representatives from U.S.-based NGOs and government agencies (USAID, the National Aeronautics and Space Administration (NASA), the Forest Service of the U.S. Department of Agriculture (USDA), the Fish and Wildlife Service of the U.S. Department of the Interior, the Peace Corps, the University of Maryland, World Resources Institute (WRI), World Conservation Society, World Wildlife Fund, the African Wildlife Foundation, the Biodiversity Support Program, and Conservation International) (For additional information see: **http://carpe.umd.edu/**).



WRI's Global Forest Watch is designed to infuse transparency and accountability into decision-making processes that determine how forests are managed and for whom. They track the corporations, government agencies, and individuals that are sponsoring logging and other development activities, map where they are operating (using GISD tools), and monitor the degree to which they are following national and local management laws and regulations.

In Gabon, for example, Global Forest Watch works with local organizations to collect and distribute information on forest development. Increased public access to information on forests and forest development holds public officials and forestry accountable and fosters better management of forest resources. Global Forest Watch provides reports, maps and data on forests and logging (For additional information see: **http://www.wri.org/forests/** and **http://www.globalforestwatch.org/english/index.htm**).

Southern Africa

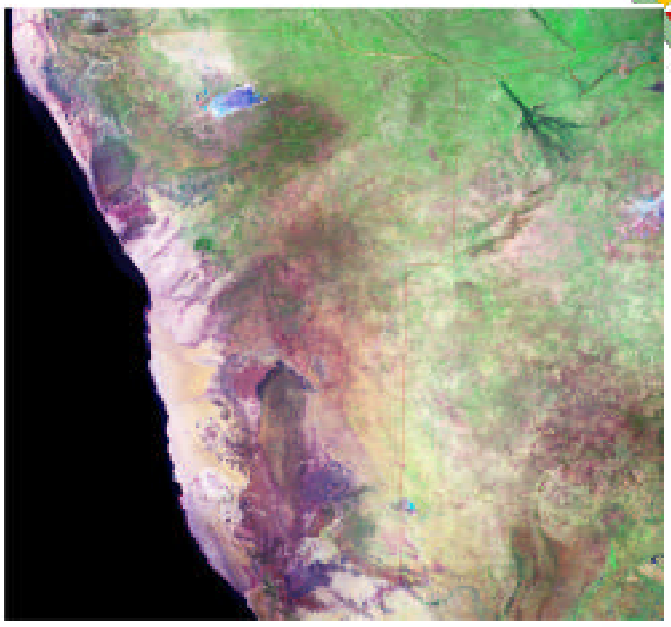
Community Based Natural Resource Management, Climate Hazards and Flooding

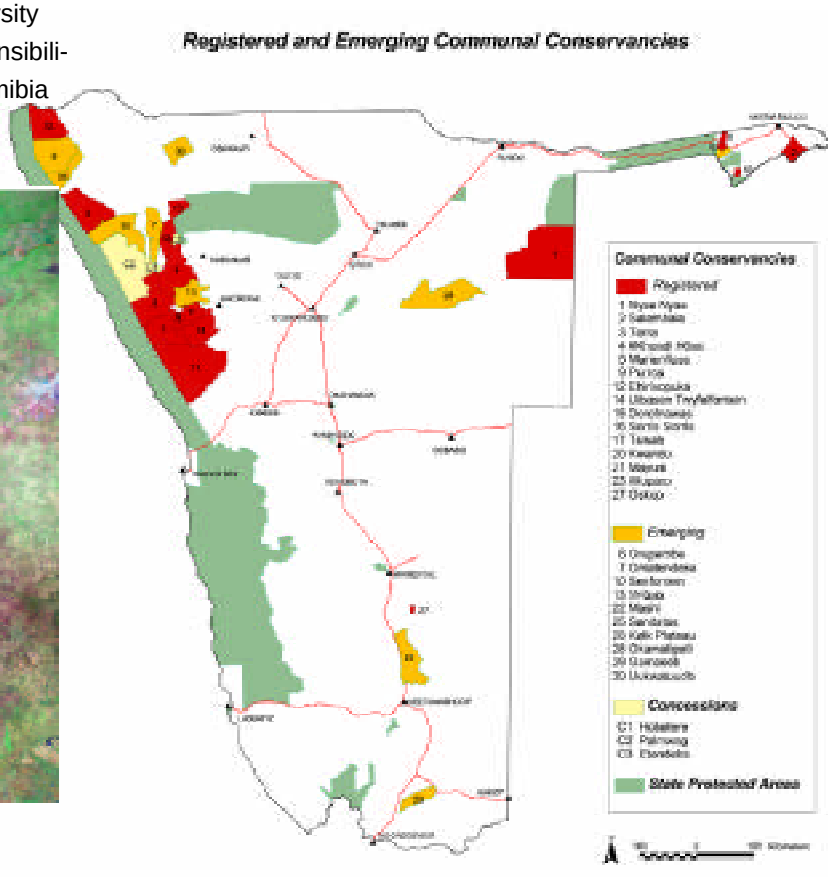
Conservancies empower local people to make their own decisions about their own resources, while enabling them to benefit from these resources. Conservancies should be seen as creating an institutional infrastructure in helping to diversify rural economies. Through the conservancy system, my government has created an environment and an opportunity for natural resource based industries to develop.

Dr. Sam Nujoma, President of the Republic of Namibia

Namibia uses Community Based Natural Resource Management (CBNRM) to promote sustainable use of its natural resources with a strong emphasis on biodiversity conservation. By devolving the rights over and responsibilities for wildlife and tourism to rural communities, Namibia created enterprise and income generating opportunities, enabling local communities to actively pilot their own future. The Living In a Finite Environment (LIFE) program in Namibia implements a CBNRM program targeted at a) economic development and the improvement of rural livelihoods in the Conservancy areas of rural Namibia, b) environmental management of wildlife and related natural resources and c) empowerment of historically disadvantaged Namibians through democratic participation in the creation and management of Conservancy organizations. CBNRM has been practiced in southern Africa in five countries. LIFE has been and continues to be a leader in innovative CBNRM programming in the African region.

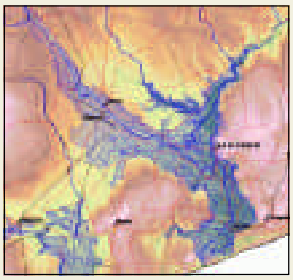
GIS services are important tools for this effort. GIS remote sensing technologies provide much needed assistance in such areas as mapping, natural resource inventory, and research support, in response to specific needs of the Conservancies and Partners. In addition to USAID, the major partners in this effort include the Namibia Nature Foundation, the Namibian Ministry of Environment and Tourism, and the World Wildlife Fund for Nature (WWF). Using GI science to respond to user needs has had the additional benefit of generating trust between partners and a common vision between the government, communities

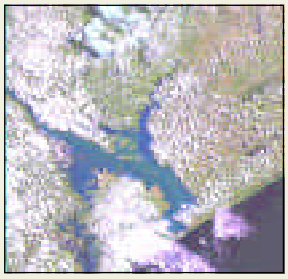




and non-governmental organizations.

The 2001 flood of the Zambezi River affected approximately 12,383 square kilometers and 324,732 people. Through the use of satellite imagery and hydrologic modeling, important partnerships in Mozambique created the Mozambique Integrated Network for Decision Making (MIND). It has built upon existing infrastructure for issuing flood and cyclone warnings to address large cross-boundary problems. Satellite rainfall estimates, for example, combined with soil condition, vegetation and other





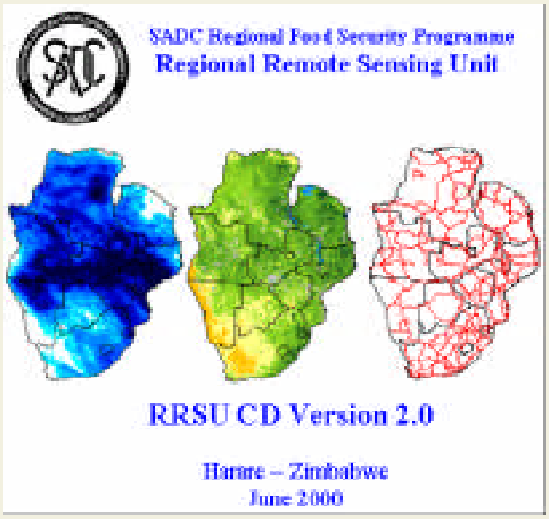
information now present a clearer picture of flood risk.

A key partner for the sharing of data in Southern Africa is the Regional Remote Sensing Unit (RRSU) of the Southern African Development Community (SADC, see: **http://www.sadc-fanr.org.zw/rrsu/rrsu.html/**).

The major U.S. partners in this effort include USAID, the U.S. Geological Survey (USGS) of the U.S. Department of the Interior, the Climate Prediction Center of the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, NASA's Goddard Space Flight Center, and the NGO, Chemonics International.

The Miombo Network was formed to create a regional network for global change research on the dominant biome of Southern Africa. Through this effort, predictive models are being developed to examine the consequences of land use/land cover changes on regional climate, natural resources, water resources, carbon storage and trace gas emissions and to develop an understanding of woodland structures and functions. Mapping was done using Landsat data in conjunction with Southern African national mapping agencies. Other activities included Database Development, Field Experiments and Modeling.

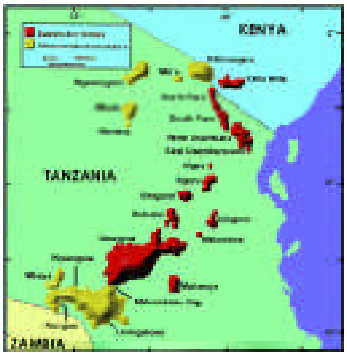
The Miombo Network is a regional alliance of researchers working on land-use and cover changes. Members in Africa include government, university and research institutions in the Democratic Republic of the Congo, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe. Elsewhere, members include universities, research institutions and non-governmental organizations in Australia, Europe and the United States. The main sponsors are NASA, the World Wildlife Fund for Nature (WWF), the National Science Foundation (NSF), and the Global Change System for Analysis, Research and Training (START) (see: **http://miombo.gecp.virginia.edu/miombo_new/index.html/**).



Eastern Coast of African

Deforestation, Land Degradation and Coastal Zone Management

The Eastern Arc Mountains of Tanzania and Kenya are a chain of isolated mountains under the climatic influences of the Indian Ocean. At one time, the Eastern Arc Mountains were heavily forested. However, much of the original forests are now gone. Internationally, the Eastern Arc Mountains are recognized as an important forest biodiversity hotspot and, by the WWF, as a "Global 200 Hotspot."



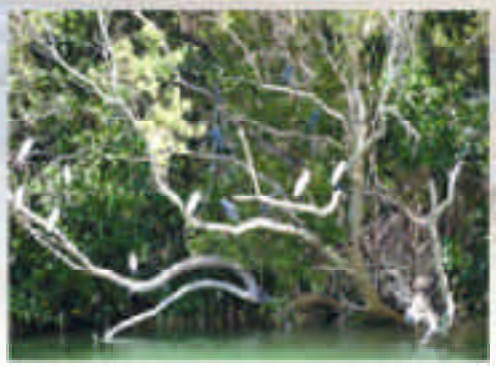
The Eastern Arc Mountains remain an important source of hydropower and water for the local population, provide a wide array of forest products, and are important agricultural production areas. However, a loss of biodiversity and sustainability has also resulted. Such factors as deforestation from fuel wood collection and charcoal production, expansion of agriculture, and under-canopy cultivation and grazing, place additional stress on the forest ecosystem. As a result, the important linkage between the forest and human health is on the verge of breaking. Food sources, such as fruits, nuts and mushrooms, are less plentiful, as are many of the plants traditionally used for healing. Wood for fuel and heating and supplies of clean drinking water are growing scarce.

Partnerships were developed at the local, national and international levels to assess the forest's biodiversity and health, and to develop effective strategies for sustainable forest management. The primary partners include: Sokoine University of Agriculture in Tanzania, the Kenyan Ministry of Environment and Natural Resources, the Kenyan Forest Health Centre, Moi University of Kenya, the USDA Forest Service, the University of Georgia and West Chester University in the U.S.A., and the USAID.

Using a combination of remote sensing, GPS, permanent plots and special aerial and ground survey techniques, the partners provided land managers, planners and policy makers, and local communities with information on the status of the forest ecosystem. Decision-makers now have access to much-needed indicator data and trend analysis.

The project has promoted cooperation among national specialists, other investigators, and government officials responsible for the protection of the region's natural resources. Land use changes, such as deforestation, were measured and documented with the use of remote sensing technology. Forest health conditions were described on the ground by the establishment of a series of permanent plots (For more information see: http://www.easternarc.org/).

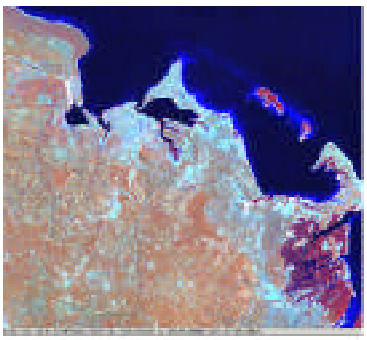
Tanzania's coastline stretches for 800 km. Its five coastal regions contribute about one third of the national GDP and contain about 75 percent of the country's industries. Newly initiated activities in the coastal region, including coastal tourism, mariculture development and natural gas exploitation, are seen as important resources for national economic development. However, much of the coastline is remote and pristine, with fringing coral reefs. Rapid development and population growth threaten coral reefs, fish breeding areas and other coastal resources that are critical to food security and the livelihoods of coastal villages and future economic growth. A doubling of the coastal population is projected in as little as twelve years, which could mean 16 million people living on Tanzania's coast by 2010. Finding enduring solutions to the complex problems facing these unique areas, where considerable ecosystem services and high population pressure coincide, is a major challenge.



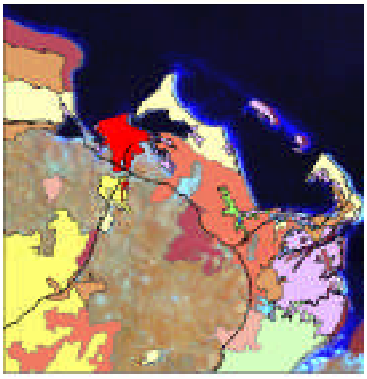
With the aim to wisely conserve and develop coastal ecosystems and resources, satellite imagery and digital image processing was used to construct GIS maps for Tanzania's coastal areas. This was combined with other existing data to analyze rates of change over time in resource and land use patterns to determine what has changed and where the change is the greatest. Changes in the shoreline, mangrove and coastal forests, and urban growth were among the areas of principle focus. Numerous field observations were conducted to support these assessments, using GPS to ensure critical areas were accurately referenced on the resulting maps.

As a result, priority areas for coastal action planning and conservation, aquaculture, tourism development and land use zoning were effectively identified. The Government of Tanzania now has a firm scientific basis from which to manage its rapidly changing coastal areas.

The U.S. collaborators on this effort include NASA, the National Imagery and Mapping Agency (NIMA), the National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, the National Research Council, USAID, the U.S. Environmental Protection Agency, the Coastal Resources Center and the Laboratory for Terrestrial Remote Sensing of the University of Rhode Island, and the USGS. The Tanzanian collaborators included the Institute of Marine Sciences of the University of Dar es Salaam, the National Environment Management Council, and the Tanzanian Coastal Management Partnership.



Imagery is selected based on the needs of the project and data availability. Once selected, the images are imported and geo-rectified. Using a GIS software package, the satellite imagery can be used as a backdrop and polygons drawn around the different land cover types as they are seen on the image.



Each polygon is labeled with the appropriate land cover category ID completing the land cover map. This step is often difficult to accomplish using imagery only. Reference data such as previous maps and ground reference data aid in making classification decisions.

Horn of Africa

Disease Control and Land Cover Change

Tropical diseases such as malaria and African guinea worm are closely linked with polluted water sources and poor sanitation. Conventions and other steps aimed at reducing waste and eliminating the use of certain chemicals and substances can go a long way to creating a healthier environment. But we also need to know better how and where to act—meaning that research and development are especially important, particularly studies that focus more on the diseases of the poor than has historically been the case.

Statement by the United Nations Secretary-General Kofi Annan, "Towards A Sustainable Future," The American Museum Of Natural History's Annual "Environmental Lecture," delivered by Mrs. Nane Annan, New York, 14 May 2002.

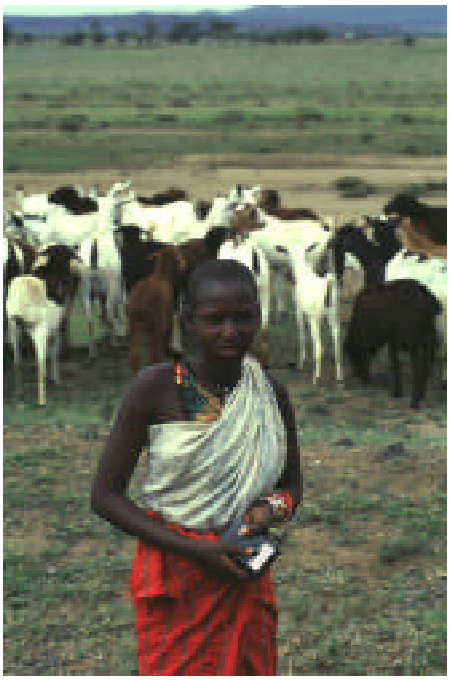
Ideally, public health professionals begin a rapid medical surveillance program for snail-born diseases, such as schistosomiasis, at the disease's earliest stages. Monitoring the habitats which give rise to these diseases and tracking the environmental changes as they occur help health professionals better determine the risks of an outbreak. These data become essential elements of an early warning system. Adding agro-ecological data to a climate-based forecast system also assists development planners in assessing the risks of snail-born diseases in relation to water projects, which impact habitats.

With special reference to schistosomiasis, a GI science network on snail-born infections was established to facilitate collaboration among health workers developing a computer-based model used for disease control programs. It links together health agency workers from the Kenyan Medical Research Institute with those in Uganda and Rwanda, making it possible for them to exchange data, discuss results of computer modeling, and collaborate on applications. An internet site was established (see: http://www.gnosisgis.org/) to facilitate the interaction and to create a 'virtual research group' of health professionals.

The computer models were assembled using climate models, earth observing data, disease prevalence data, distribution data on snail hosts, and digital maps of key environmental factors which affect development and propagation of snail-borne disease agents.

These data are used to develop a climate-based forecast system, including identification of short term life cycle-limiting seasonal temperatures on the major schistosome-snail host systems that occur in a region.

This public health effort has led to the creation of a digital data resource on CD, which is part of a database for the Intergovernmental Authority of Development/Nile Basin region of East Africa. Important alliances were established also with the World Health Organization, the Food and Agriculture Organization (FAO), Louisiana State University and the University of New Mexico in the U.S.A., and the Danish Bilharziasis Laboratory with regional GI science networks in East Africa. The possibility now exists for future disease control linkages in Southern Africa, West Africa, Latin America and South Asia.

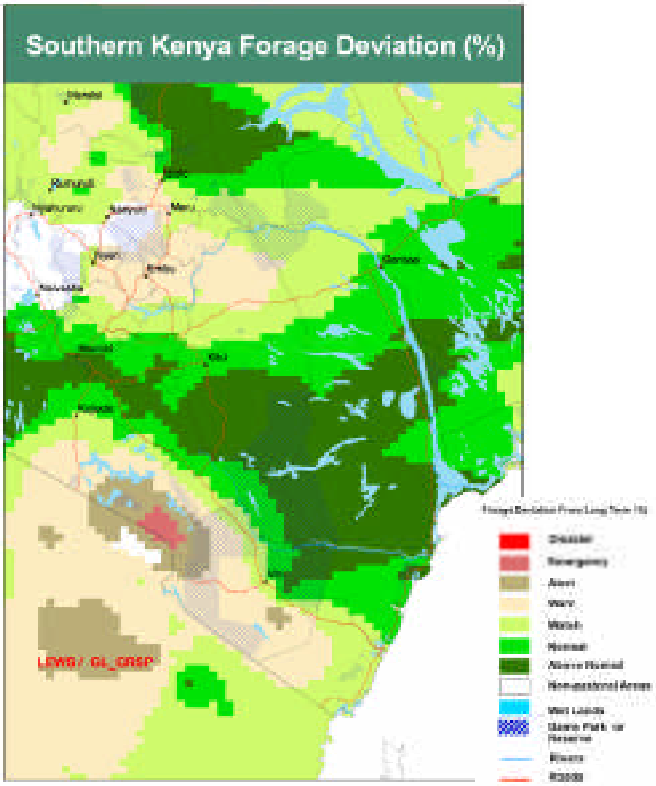


The Livestock Early Warning System (LEWS) links new technologies to detect changes in livestock forage and nutritional status over large landscapes. Computer models were developed to analyze livestock nutrition and foraging. An accelerated fecal monitoring system employs Near Infrared Spectroscopy to improve sample collection. Spatial Characterization and other GI science methods enable the network of collaborators to more accurately respond to climatic conditions that influence livestock production. Similarly, World Space Satellite Radio linked to computers enhances communications between

key government ministries, inter-governmental authorities, and NGOs, as well as supporting community outreach efforts. The major U.S. partners in this effort are USAID and the Texas A&M University System. Ethiopia, Kenya and Tanzania are the principal African partners, with strong support also from the Association for Strengthening Agricultural Research in Eastern and Central Africa, the International Livestock Research Institute, and the Inter-Governmental Authority for Development (including the Drought Monitoring Center and the Regional Center for Mapping Resource Developments).

Another important partner is Africover, which provides a regional spatial standardized database. The first phase has been undertaken in Florence, Italy, at the Instituto Agronomico per L'Oltremare (IAO). Field work has been completed along with data interpretation and digitization.

For a fuller discussion of Africover, please see the African Continent section of this booklet (also see: http://www.africover.org/).



Vanishing Icecap of Kilimanjaro

The Byrd Polar Research Center of Ohio State University has monitored changes in the glaciers of Kilimanjaro. According to Dr. Thompson, Senior Research Scientist, Kilimanjaro has lost 82 percent of the icecap it had when it was first carefully surveyed in 1912. Measurements taken in 2000-2001 on Kilimanjaro during the study show that its glaciers are not only retreating but also rapidly thinning. An important partner in this research effort is the Division of Early Warning and Assessment of the United Nations Environment Program (see: http://www.unep.org/dewa).

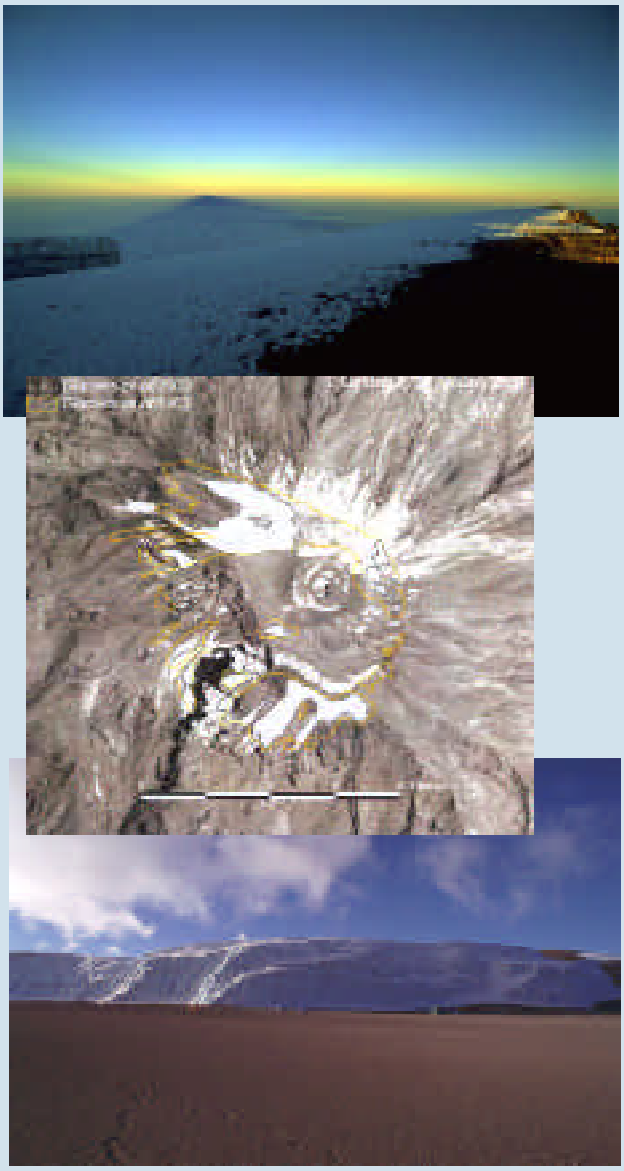


Photo Credit: Carl Rosenberg, Leonid Kruglyak and Carl Axel Rosenburg

Northern Africa

Information Infrastructure

In North Africa, as in the rest of the continent and around the globe, stimulating widespread interest and investment in environmental and natural resources management are important national objectives. Governments in the region are racing to eliminate the barriers to economic development and they are facing a population which is demanding greater accountability and transparency. Ensuring that development is being done in a context of wise use and sustainability, and recognizing that economic and social development go hand in hand, are also growing challenges. These countries are quickly realizing the importance of data and information in today's decision-making process.

National Spatial Data Infrastructure (NSDI) provides an important framework of standards, policies, data and procedures, and technology to support effective coordination and dissemination of geographic information. NSDI provides all levels of government, the commercial sector, NGOs, academic and research institutions and individuals with the basis for evaluation and decision-making using geographically referenced information. In this way, consistency is maintained between datasets, even when data is collected and maintained by different authorities or entities.

FAO is presently working in Morocco, Tunisia, Libya, Egypt and elsewhere in North Africa to establish NSDIs as a means of managing and disseminating information. In Egypt, for example, the Egyptian Environmental & Remote Sensing Services Center was established in 1988 and currently represents eight companies in the field of remote sensing, providing a wide array GI-based data and software systems (see: http://www.erss.com/). An important partner in this region is the Sahara and Sahel Observatory (OSS), an independent international organization based in Tunisia, which is building an African arena for cooperation and exchange to combat desertification and poverty. It does so by working with African partners to harness, disseminate and share information for sustainable natural resource management (see: http://www.unesco.org/oss/).

The Environmental Information Circulation and Monitoring System on the Internet (SISEI) is an important national and sub-regional capacity building program being implemented in North Africa and elsewhere on the continent. SISEI is an environmental information management tool to assist in implementing the legal instruments relating to the environment in Africa: land degradation, biodiversity, climate change, wetlands and is based on new information and communication technologies. The general objective of the SISEI program is to reinforce the capacity of countries and regional organizations in Africa to set up systems for

Photo Credit: R. Senseney

Photo Credit: B. Zenzouni

the validation, circulation and harnessing of relevant environmental information. This, in turn, will strengthen public participation at the different decision-making and operational levels and thereby promote enlightened decision-making (see: **http://www.sisei.net/**).

The Network for Long Term Ecological Monitoring Observatories (ROSELT) Program was the first federating program of OSS for the implementation of a Mechanism for the Observation, Monitoring and Evaluation of Desertification (DOSE). ROSELT's objective is to promote and support long term programs for environmental monitoring in arid zones affected by land degradation (see: **http://www.roselt-oss.teledetection.fr/index_en.html/** also see: **http://www2.unesco.org/oss1/v_uk/programmes/programme_roseltang.htm/**).

North African countries are also finding that NSDIs support other economic and social activities. In addition to providing the countries, themselves, the opportunity to participate in the knowledge economy, these countries are experiencing the emergence of a more informed and empowered population, and are setting the stage for the development of a private sector involved in the analysis and sales of the data.

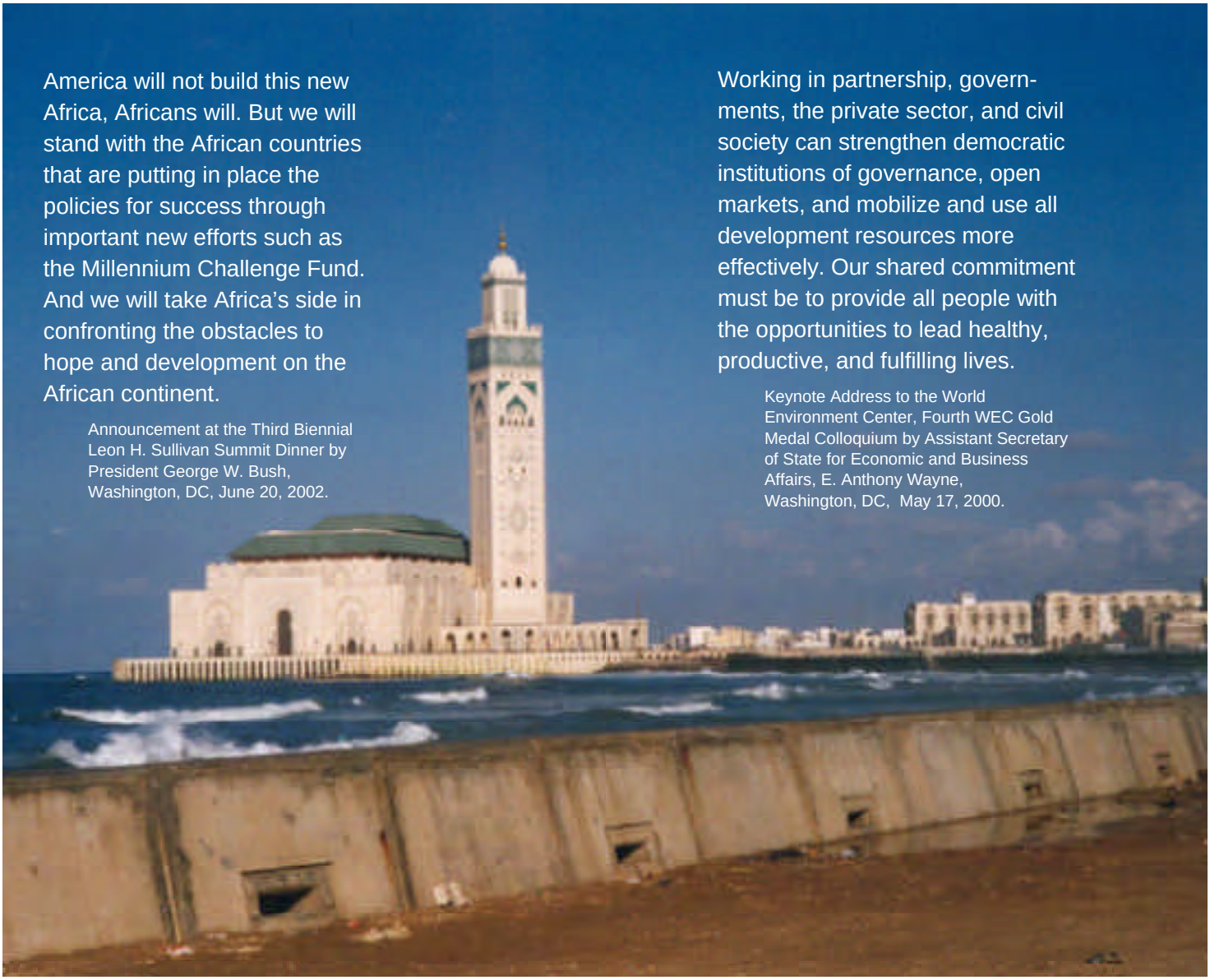


Photo Credit: R. Senseney

African Continent

Continent-wide efforts

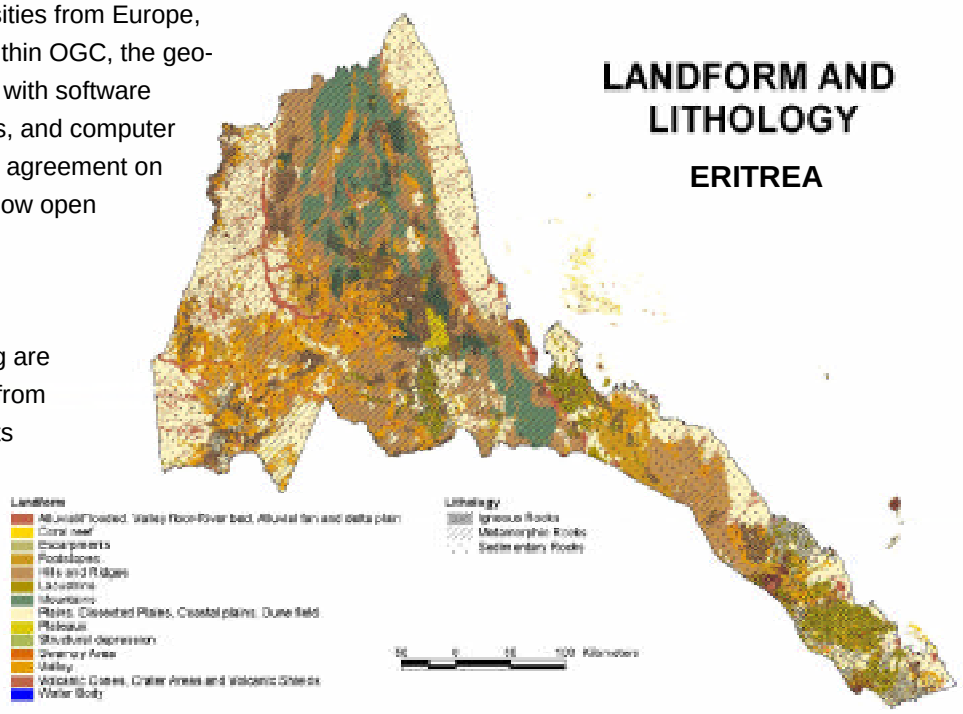
Geography serves as the common thread to weave together diverse types of information relevant to sustainable development. GI, however, often comes in large, complex databases with a variety of different formats. It comes from different sources, each with their own way of describing things. They vary in spatial and temporal resolution. They range widely in quality. Metadata describes how data is organized and helps to promote the use of data standards. This contributes to documenting spatial data in a consistent manner and makes the vision of easy, "one-window" access for GI more achievable.

Ensuring that the technologies used to store, share, analyze, manipulate, exchange and communicate data can operate together (interoperability) is also a considerable challenge. To ensure that information technology tools, such as software, hardware, and protocols, work together and facilitate data exchange and communications, an international forum, known as the Open GIS Consortium (OGC), was formed. OGC includes more than 230 industries, government agencies, and universities from Europe, Japan, Australia and North America. Within OGC, the geoprocessing technology consumers work with software vendors, earth observation data vendors, and computer and other technology providers to reach agreement on the technical specifications which will allow open interfaces between GI systems (see: **http://www.opengis.org/**).

Most efforts at natural resource planning are focused at the country level in isolation from neighboring projects, complicating efforts to do strategic planning at the sectoral, regional or continental levels. To better judge the overall impact of individual efforts, FRAME was created as a FRAMEwork through which analysts and decision-makers may think strategically about environmental and natural resource management issues in relation to the challenge of sustainable development in Africa. FRAME brings together people who rarely interact, catalyzing new working relationships to share information and broadening perspectives through contact groups, sponsorship of special studies, electronic networking, and partnership support (see: **http://www.frameweb.org/**).

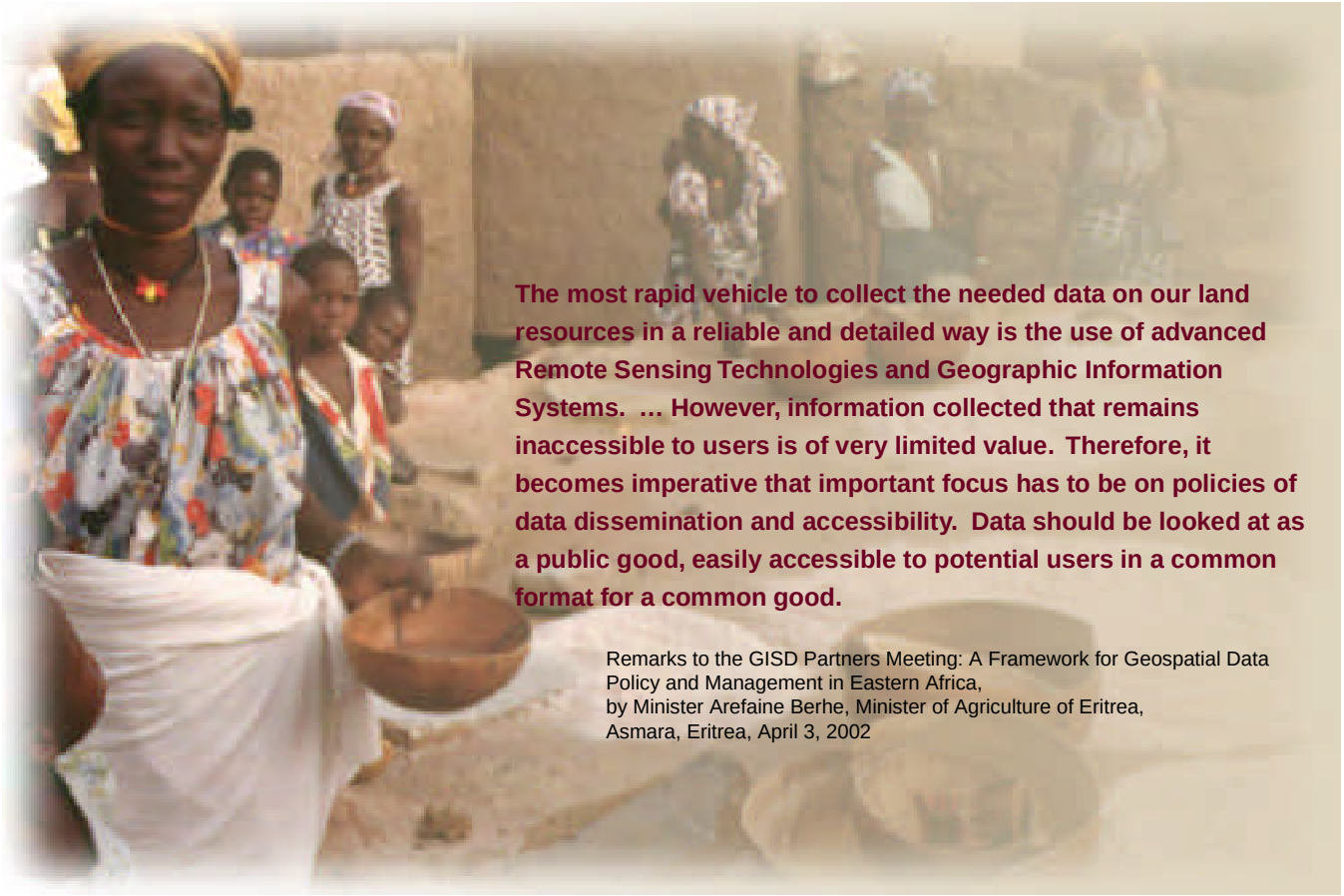
Another important mechanism to improve management of natural resources at the local level is the Natural Resource Management Tracker (NRM Tracker). NRM Tracker is a database which allows local users to enter their experiences of local resource management. This web-based application enables local communities to share lessons learned and to benefit from the experiences of others (see: **http://www.nrmtracker.org/**).

The Africover Project's ambitious and unique goal is to establish, by and for the whole of Africa, a digital, georeferenced Multipurpose Africover Database for Environmental Resources (MADE). This project generates land cover and environmental information that can be accessed by users at local, national and regional levels. Africover products rely on remote sensing data and GIS. The land cover is mainly derived from visual interpretation of recent high-resolution, digitally enhanced, satellite images. This is



done according to the FAO Land Cover Classification System (LCCS), which can serve as a worldwide land cover reference basis. Other outputs of the project include the Africover Interpretation and Mapping System (AIMS), an advanced on-screen interpretation software, the Africover Database Gateway (ADG), a browsing tool for the Multipurpose database, and the Africover Interactive Database (AID), which can be used in photo interpretation processes for land cover/land use. Africover was initiated by the FAO with funding from the Government of Italy, and has focused on 10 countries: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Kenya, Rwanda, Somalia, Sudan, Tanzania, and Uganda (see: **http://www.africover.org/**).

The goal of EIS-Africa is to make high quality GI readily available and accessible to policy-makers, decision-makers, and civil society at all levels in support of sustainable development. EIS-Africa is a pan-African, NGO network of public and private institutions and practitioners, working to strengthen African capacity and to generate, manage and freely disseminate reliable environmental data. The EIS-Africa GI products, tools and services also foster transparency, accountability and credibility—essential elements of good governance—and support the establishment of democratic institutions (see: **http://www.eis-africa.org/**). WRI is a major partner in EIS-Africa (see: **http://www.wri.org/**).



The most rapid vehicle to collect the needed data on our land resources in a reliable and detailed way is the use of advanced Remote Sensing Technologies and Geographic Information Systems. … However, information collected that remains inaccessible to users is of very limited value. Therefore, it becomes imperative that important focus has to be on policies of data dissemination and accessibility. Data should be looked at as a public good, easily accessible to potential users in a common format for a common good.

Remarks to the GISD Partners Meeting: A Framework for Geospatial Data Policy and Management in Eastern Africa,
by Minister Arefaine Berhe, Minister of Agriculture of Eritrea,
Asmara, Eritrea, April 3, 2002

Conclusion

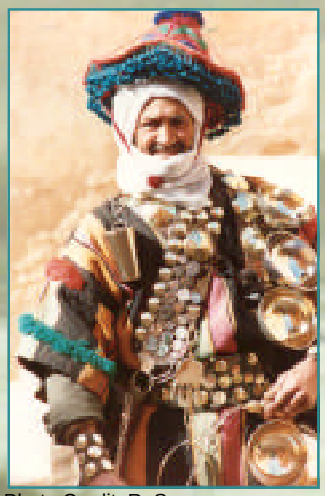


Photo Credit: R. Senseney

These selected summaries demonstrate that many African users are already benefiting from the GISD partnerships and initiatives. Still, many challenges remain. The Internet and CD technologies have become important mechanisms for sharing and transferring data and analyses. But the technologies needed to support use of GIS have not reached all countries, or all sectors of African economies.

Also, few private firms have emerged to deliver remote sensing services at the community level. National governments and international agencies remain the principal drivers of demand for GIS analysis, and GI capabilities at the community level remain inadequate.

The GISD initiative is focusing on results-oriented partnerships for applying GI to sustainable development challenges at international, national, and local levels. GISD-supported workshops and meetings have been conducted thus far in three regions of Africa: in Bamako, Mali, in Western Africa in March 2002, in Asmara, Eritrea, in the Horn of Africa in April 2002, and with some of our Southern African partners in Nairobi, Kenya, in May 2002. Over 100 presentations from these meetings are available on the website: **http:www.opengis.org/gisd** and more meetings are planned. The meetings address real issues: how data from different sources can be combined to tell a coherent story, with sufficient detail for decision-makers at local and regional levels to manage natural resources, prevent diseases, and improve food security.

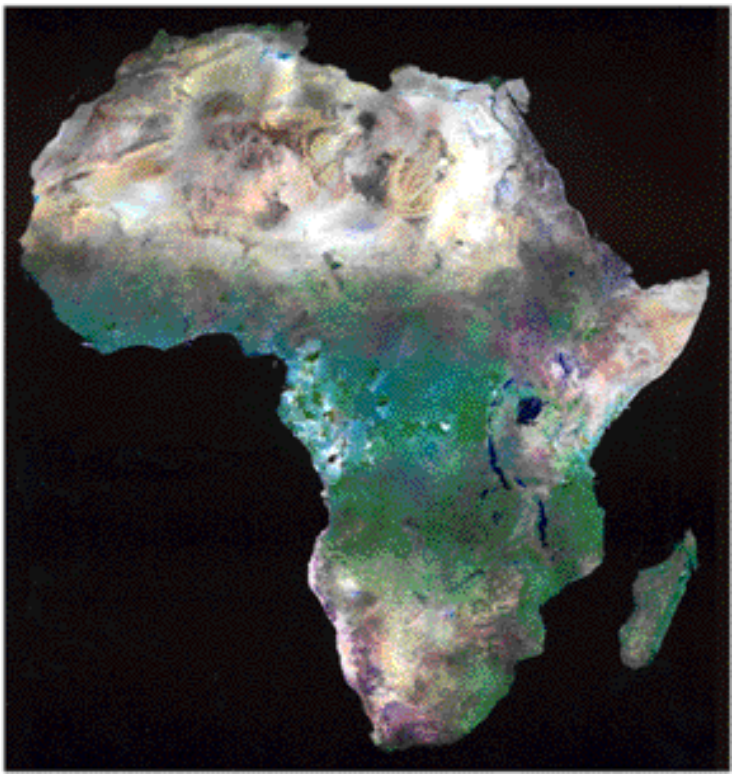
GISD-promoted projects illustrate the important role traditional indigenous knowledge plays in documenting resource and environmental changes. They show how this information, when augmented with current observations and combined with advanced technologies, such as GPS, create a geographically referenced assessment of the past and present. They document how the scientific community, NGOs, governments, and international institutions are forging strong public-private partnerships at the community, national and regional levels. They underscore the importance of training, education, and technology transfers in building the human and technical capacity to move this process forward.

GISD is making a difference in Africa, and holds great promise for the rest of the globe. Ideally, this process should be user-driven. It should begin with the need to make a specific decision or assess an existing practice. It should be initiated at the local level—be it a farm, forest area, park, or coastal fishery. It should support sustainable development in all important sectors, including water, energy, health, agriculture, and biodiversity. At that point, GISD will have achieved its ultimate goal, to bridge the GI digital divide in direct support of environmentally and economically sound decision-making for the new millennium.

Photo Credit (background image): R. Senseney

GEOGRAPHIC INFORMATION FOR SUSTAINABLE DEVELOPMENT

http://www.opengis.org/gisd



The long-term strategic goal and vision for Geographic Information for Sustainable Development is to make satellite imagery available to policy makers, to users, to scientists around the world

> . . . so that they can get instant access to satellite photography, and these pictures will help them map watersheds, plan agricultural crop strategies, and trace urbanization trends. Linking that kind of technology to GPS technology gives us all kinds of new avenues to increase productivity and to bring the power of technology to the most distant corner of the world, the darkest corner of the world.
>
> Remarks to the National Academy of Sciences Annual Meeting by Secretary of State Colin L. Powell, Washington, DC, April 30, 2002.

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